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# Pellet, a Way to Exit from One-Product Economy

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**ABSTRACT:** Nowadays all of the countries want to consume the resources in optimum way and try to reach more national product by less usage of resources. Pellet is placed in list of biological fuels and accounted as a renewable resource. In this research we examine the consumption trend of Pellet and entering of The Islamic Republic of Iran to the Pellet market. For this purpose we model the Pellet trade flow and examine the trade opportunities in the markets of producing countries. Based on the presented results it can be inferred that the trend of pellet consumption will not decrease in the coming years and the mentioned trend is close to EU 2020 targets based on providing safe energy. Also according to the results, except the current Pellet producers, there will be other production sites to take market share. Therefore, it seems that producing wood pellets inside the country is justifiable.

**KEYWORDS:** Pellet, Biological Fuel, Sustainable Economic Growth, Market Share.

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## 1. INTRODUCTION

Access to natural resources has been for ages the cornerstone of economic prosperity and ensuring abundance in raw materials is perceived as the promise of long run growth. The other side of the coin is that depletion of limited resources put increasing pressure on nature and on the production process. Output expansion generates human waste that hurts the environment and penalizes the ability of nature to regenerate. This conflictive dynamic of economic growth calls for the use of more efficient technologies. From the normative side, it raises the question of what policy measures should be applied to achieve sustainable growth, *i.e.* "a balanced growth path with increasing environmental quality and outgoing growth in per capita income (Brock and Taylor, 2004a, p.2-3)". From a positive point of view, the ability of market forces to freely balance the pros and cons of an extensive development is called into question by natural scientists. The reduction of the use of fossil fuels will in all probability imply that the amount of energy coming from biomass (and also biofuels) will increase (Najafzade et al, 2014). Wood pellets are part of the wood fuel family such as firewood, charcoal and wood chips. In other words, a wood fuel is simply any type of wood or wood derivative used as a fuel. Wood pellets can consist of all kinds of wood types, softwood or hardwood (e.g. pine and bamboo) and other wood derivatives (e.g. bark). A wood pellet is generally made from compressed sawdust which originates as a by-product of the pulp & paper industry; sawmill industry and other wood transformation activities. As the interest in wood pellets has increased dramatically, wood pellets have transformed from being a clever by-product to an actual trading commodity. Wood pellets are now not only considered as a by-product but in fact they are considered as an actually industry. When biomass has been pelletized a lot of the water is removed, and the dried biomass has much higher energy content. The removed water and lower material weight also is an advantage when transporting the fuels, because it is possible to transport a larger amount of energy transportation. Producing and transporting a wood pellet in Denmark required a consumption of 3.6% of the total pellet energy content when the pellets were produced domestically. For the sake of longer transportation distance, the consumption of imported wood pellet production and transportation accounts for 4.5%. The transporting and shipping wood chips have a total consumption that accounts for 3.3% of the total energy content. Thus wood pellets are easier to handle, because of the low humidity content and the ability of being piled. Other wood fuels containing water cannot be piled because of the danger of gas generation. Therefore, Pellets are often easier to handle compared to wood logs or wood chips for both industrial and residential consumers (Werling, 2010). The energy content of a fixed quantity of raw wood is different due to the water content. Wood pellets are seemed to be more stable[4] and they are considered as a clean fuel to the heat or to power producers as the humidity always is low and the energy content is always stable centred on 17-17.6 GJ/tonnes (woodenergy.ie, 2010). Thus one could conclude that the energy consumed by the pellet process is insignificant compared to the benefits. The most dominant attribute of wood pellets is that they are straightforward to implement in a heat and power plant. Furthermore, this type of fuel only requires a rebuilding of an existing coal plant, and within a fair time horizon it is possible to cut the GHG emissions and produce carbon neutral energy on already existing coal fired[5]. Pellets

[4] If we are looking at a more extensive increase in the use of pellets, other raw materials or mixes of raw materials have to be used. As an example, cull tree and short-term thinning material may come into use. The characteristics of pellets made from these materials would be similar to those of the present pellets, although the ash content is twice that of stem wood pellets (Martinsson & Österberg, 2004).

[5] In December 2008 The European Union (EU) decided on ambitious targets to raise the share of renewable energy sources in the final energy consumption. The EU countries are obliged to participate in achieving the total EU goals of

- ✓ Reducing greenhouse gas emissions by at least 20% in relation to achieved 1990 levels
- ✓ increasing the use of renewable energy to 20% of total energy production

(wood chips and ground wood, too) are also could be burned alone or co-fired with coal. This trend reduces GHG emissions (Indeck Energy, 2010). Wood pellets have been used since the 1930. This kind of fuel became popular during the oil crises in 1973-1979[6]. Europe and North America's desperate need for alternative fuels forced them to redeploy wood pellets in order to produce energy. The pellets quickly became popular because of the high quality and local access causing the price to increase. As the price of oil stabilized again wood pellets seemed to fall into oblivion. In the 1990 producing sustainable energy and being less dependent on fossil fuels were again in focus and once again wood pellets seriously entered the market. Sikkema et al (2009) have studied the markets of fuel pellets. According to their results, in Europe there is a yearly consumption of wood pellets on 9 million tonnes. Elingaard –Larsen (2010) have studied the supply chain and according to their results Russia is an example of where a wholesaler is a necessity because of the language and culture barriers to European countries. Vivarelli et al (2009) targeted the consumers of wood pellets. Base on their results, Residential consumers often purchase wood pellets through a retailer who purchases wood pellets from wholesalers or sometimes directly from producers. Also according to the presented results, in Italy residential consumers are in majority and the wholesaler is usually skipped and 50% of wood pellet producers sell directly to retailers.

Market development is not only bounded to Europe. New market areas are starting to develop and large potential users like Brazil, Argentina, Chile and New Zealand are assumed to be a part of the global wood pellet flow within short term. Asia (China, Australia, India, Japan and South Korean) is booming economically and according to Peksa-Blanchard et al (2007) the Asian countries is estimated to be the biggest global energy consumers by 2030, whereas at the same time the Asian region has the largest biomass resources in the world. According to Hansen (2010) the wood pellet market will double within short time. Junginger et al (2009) estimate that the wood pellet exchange in Europe will vary between 18-25% per year and the demand will increase between 130-170 million tonnes per year until 2020. Wood pellet trades are based more on convenience and even a level of coincidences instead of tactical and strategical knowledge (Elingaard – Larsen, 2010). There have not been any resource problems in the wood pellet flow yet and still there are plenty of wood pellets on the market, but key market stakeholders foresee that it can be a necessity to overview and structure the market. As many account the increased use of wood pellets as an important step to achieve the EU 2020 goals of sustainable energy, wood pellets are considered as a significant fuel in the 21th century (Sikkema et al, 2009). Thus, increase in pellets is expected (Werling, 2010).

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These targets have obviously been formulated in order to limit GHG emissions but also to ensure more secure energy sources i.e. less dependence on imports of foreign oil, gas and coal.

[6] The oil crisis in 1973-74 made clear that the Western European countries were dependent on energy imports, mainly oil. They are no longer considered self sufficient in terms of energy. The interest shown in alternative energy sources has therefore increased. For the European Union, the White Paper concerning biomass (European Commission, 1997) aimed at doubling the share of renewable energies with respect to the total energy demand, going from 6% to 12% by 2010. In addition, the European Union published their Green Paper "A European Strategy for a Sustainable, Competitive and Secure Energy Supply" in 2006, in which they stated that all 25 member states have to cooperate to achieve a secure energy supply. Furthermore, it aims at decreasing the energy use and attaining energy efficient processes.

# 2. THEORETICAL ISSUE

## 2.1. Wood Pellets Quality

Wood pellets are mostly traded via private transactions and in many different qualities[7], packing and like almost any other consumer product wood pellets have many different types of brands. Price is not the only factor of marketability; the quality of fuel pellets, matters too. In fact, superior quality is a competitive advantage. For large industrial consumers the quality of wood pellets is not that important (Elingaard – Larsen, 2010). Totally, because of the different quality the existing pellets on the market are categorized into two main pellet types. The first is related to industrial purposes which are denoted as standard wood pellets. The second one is related to residential purposes which are denoted as premium. 95% of the wood pellets in the United States are premium pellets their ash content[8] is less than 1%. Ash content is the main criterion of quality. Even though wood pellets have very high combustion efficiency the burning of wood pellets still leaves ash residue. Standard wood pellets can produce up to 3% ash whereas Premium wood pellets contain maximum 1%. Handling the ash requires both time and special equipment. Thus it is generally assumed that residential consumers purchase premium quality wood pellets having low ash content, whereas large scale consumers are able to handle Standard quality wood pellets. PFI's proposed standards for inorganic ash content in residential or commercial Densified fuels are presented in table 1

Table 1- PFI's proposed standards for inorganic ash content (Source: PFI)

| Fuel Pellet Grade | Super premium | Premium | Standard | Utility |
|---|---|---|---|---|
| Ash Content | 0 to 0.5% | 0 to 1% | 0 to 2% | 0 to 6% |

The white wood (without bark) of most tree species has an ash content less than 1%, but most agricultural by-products and residues have ash contents over 2%. Ash is made up of minerals and salts, and the properties of ash will differ by its elements. However, producing premium pellets by using white wood (without barks) is plausible. According to the Oak Ridge National Laboratory, most agricultural residues have heating values in the range of 6,450 to 7,300 Btu/pound, while woody materials have heating values in the range of 7,750 to 8,200 Btu/pound. Wood ordinarily has low chloride and alkali content and Agricultural by-products and residues generally have higher chloride and alkali content. Wood pellets are usually hard and durable due to the lignin content and characteristics in wood. Some agricultural biomass materials would not bind together as well as wood, resulting in an inferior fuel pellet. Additives and binders may be used to improve an agricultural biomass pellet. Nevertheless, wood pellet companies would have a competitive advantage over most agricultural biomass pellet companies because their feedstock makes better pellets. All agricultural materials are not the same in terms of the characteristic that affect pellet quality. Having a steady supply of agricultural feedstock that is lower in ash, chloride and alkali and that binds into a stronger pellet would be an advantage relative to other agricultural pellet producers.

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[7] A good pellet energy quality implies high usable energy content (Granö, 2007). Avoidance of contamination by, e.g., sand particles (SiO2, Al) minimises the risk of slagging in the burners (Öhman et al., 2002).

[8] Granö (2007) lists the following factors as necessary to obtain high end product quality: good sanitary quality (keep the raw material free from dirt, dust and mould); removal of nutritious parts at harvest (cleaner flue gases); avoiding wet raw material (low and homogenous moisture content ensures higher durability of pellets); and a low amount of bark (ensures a lower ash content).

## 2.2. Wood Pellet Market

Biomass fuel pellets have two primary markets: 1- a retail market where pellets are generally delivered in 40-pound bags for use in residential and small commercial appliances. Farms and farm animal orphanages (such as aviculture, cattle and etc) place in this market where pellets are burned to generate heat for multiple purposes. 2-The second market is in the industrial, institutional and utility sectors where large quantities of fuel pellets are burned in boilers and other energy conversion systems. These fuels often co-fired with coal. This kind of market is well developed in Europe, but not in the United States. The criteria of product viability in both markets are largely the same, but requirements relative to those criteria may differ. In Europe there is a yearly consumption of wood pellets on 9 million tonnes (Sikkema et al, 2009). As said previously the wood pellet has energy content around 17–17.6 GJ/tonnes, but according to Danish Energy Agency (2010) this mount is about 17.5 GJ/tonnes. Thus, the total wood pellet consumption includes an energy amount around 140 MW. Note that 3.5% of the total existing energy consumption in Europe is satisfied by wood pellets. The wood pellet market is currently changing and developing. The wood pellet market is fairly new and stakeholders are finding their places. Therefore trading prices are hard to predict. Pricing of wood pellets for residential heating is so easy. If the wood pellet price would be approximately 130 EUR/ton we would reach sustainable market structure (Elingaard – Larsen, 2010). Also, the prices of wood pellets being about 284 EUR/ton in bags of 25 kg excluding delivery but including VAT[9]. In Austria the prices are slightly lower and in Sweden the prices are slightly higher. In Germany prices are almost the same. In Minnesota (state in the north central USA), the price of wood pellets is around 175-210 dollars/ton and this amount equivalents to 145-174 EUR/ton[10]. As large scale trading of pellets between producer and wholesaler or retailer usually is done privately, thus prices of trading premium or standard wood pellets would not be identified easily. As the trading of wood pellets is much instructed in comparison to trading oil, gasoline and natural gas which have price indexes and clearing houses[11], the trade of wood pellets might be economical. Currently the online organization Endex updates price indices of industrial wood pellets each week (Najafzade et al, 2014).

## 2.3. The Supply Chain

Generally there are three consumers in large (e.g. heat and power plant), medium and small scale (e.g. district heating, industrial boilers, large residential heating receiving huge bulk sizes) of wood pellet in the existing market. Wood pellet consumers and traders (wholesalers and retailers) purchase wood pellets either on contracts (3 months to 3 years or maybe more), in spot markets (one time transactions) and retail where residential consumers are purchasing bags of wood pellets in the local hardware store. For large scale consumers the supply chain is amazingly simple and quite direct. Alternatively there might be an additional link between wholesaler, producers and consumers. Russia is an example of where a wholesaler is a necessity because of the language and culture barriers to European countries (Elingaard – Larsen, 2010). Residential consumers often purchase wood pellets through a retailer who purchases wood pellets from wholesalers or sometimes directly from producers. In Italy residential consumers are in majority and the wholesaler is usually skipped and 50% of wood pellet producers sell directly to retailers (Vivarelli et al, 2009).

[9] For more details refer to Hansen (2009)

[10] The price of wood pellets for The United States can be obtained through www.woodpelletprice.com.

[11] Institution maintained by banks where accounts and mutual claims are settled.

### 2.4. Product Sustainability

When producing, trading and consuming wood pellets, it is of highly importance to make sure that the pellets are made of approved sustainable materials traded responsibly. In other words, a wood pellet must be sustainable. Climatic sustainability, social sustainability and economical sustainability are three types of sustainability one must consider when dealing with biofuels of any kind. When climate is sustainable the climate will not suffer any damage when raw materials are gathered. For instance if too many trees are felled at one time, it would not limit the photosynthesis or worse, the animal living conditions of the forest. Biodiversity is the variation of life forms within a given ecosystem. The biodiversity of the forests is a requirement with harvesting biomass from climate sustainable forest. The term social sustainability indicates that income distribution should be fairly divided between farmer, producer and other actors. Being social sustainable also refers to being aware of the balance between biomass crops replacing food crops. The wood pellets should on no circumstances be made in a way limiting any conditions for humans. Many of the researchers, scientists and consumers are concerned that as the price and interest of biomass increases the farmers will be more inclined to produce wood fuels instead of food crops. This increases the prices of food, together with the general growing population, which primarily will hurt the developing countries. The term economical sustainability refers to the short and long term economical interests of using biofuels. Politically subsidies must create a balance in the market, but if the subsidies are nullified, it would not result in completely movement in the existing and developing market. For almost all of the consumers, sustainability is more important. In February 2010 the EU sustainable energy commission published adaptive guidelines for solid fuels. The guidelines re-evaluated in 2012 because no agreement was made on a binding regulation or common sustainability certificate. The commission assumed that most solid biofuels currently originates from European forests. According to the commission, 95% of the produced solid biofuels within EU already is from sustainable forests and agricultures. Generally, biomass pellet fuels (i.e. woody and agricultural biomass pellets) are considered as a sustainable product.

## 3. METHODOLOGY

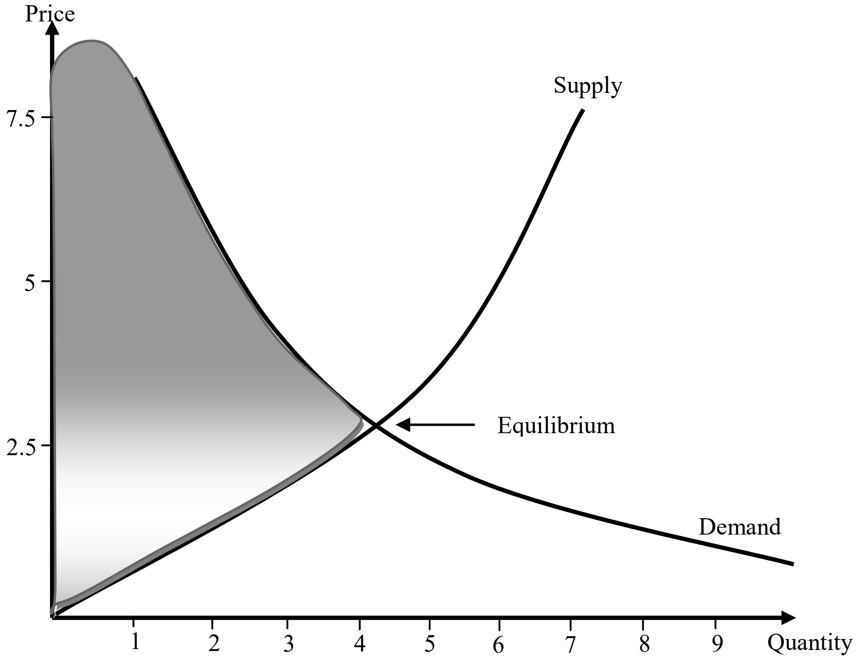
Supply and demand is one of the basic mechanisms of economics. The term demand refers to the quantity of a product or service a customer is willing to buy at a certain price. Furthermore, the term supply refers to the quantity of the given product or service a supplier is willing to sell when receiving a certain price. The law of demand states that, while holding all other conditions constant, the consequences of a product or service market price increase is a decrease in demand. Also, any influence other than the price of the product changes, such as income or taxes, will change the demand and the entire demand curve will shift (either in left or right direction). A change in the demand curve will result in a new point of intersection between supply and demand and the balance will differ from before. A demand curve shift to the right will result in an increase in demand, while a shift to the left results in a decrease in demand. The law of supply states that, while holding all other conditions constant, the suppliers will be willing to sell a higher number of products when the market price of a product rises. Suppliers will be bounded by their costs and production restrictions. Furthermore, according to the law of supply a supplier will try to supply the consumers if they can cover their costs.

### 3.1. Market equilibrium and elasticity

Market equilibrium is defined as the intersection of supply and demand curves. When the market reaches equilibrium there is a perfect balance between supply and demand. In this point the quantity demanded and the quantity supplied are equal. In figure 1 both the demand and supply curves are shown. The supply curve is assumed as perfect competition in the model which is given by the production cost of the product. Distinguishing the intersection between the two curves is the same as maximizing the area under the demand and over the supply which is shown in figure 1 with grey colour. Utility is defined as the utility of the consumers when receiving, purchasing or owning a product. The consumption will increase if the price of wood pellets decrease. The degree of curve is the degree that the curve reacts to a change in price. As some products may be more essential to the consumer than others, therefore, elasticity varies among products. Also, the products that are considered as necessities are more insensitive to price changes because consumers would continue buying these products despite price increases. The price elasticity, denoted $E$, is defined as

$$\mathrm{E} = \frac{\%\ \text{change in the quantity demanded}}{\%\ \text{change in price}} \qquad (1)$$

Figure 1. Market Equilibrium and Profit Maximazation (Source: authors' design)

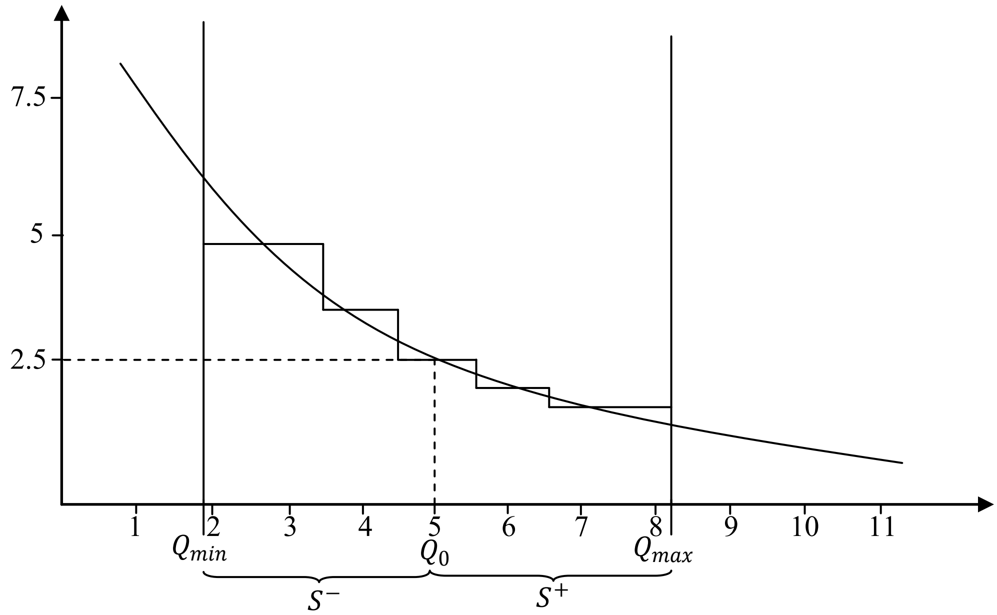



As mentioned previously, the law of demand dictates that demand decreases when the price increases. Hence, the price elasticity will be negative. These products are denoted as normal goods. Products that have a positive elasticity are denoted as inferior goods. The law of supply, when assuming perfect competition, states that suppliers will supply if their costs are covered. The market equilibrium, in the model, is when production costs equal consumers price willingness. This also implies maximizing the consumer's utility.

## 3.2. Linear implementation

In almost all cases the relationship between supply and demand is not constant ($E \neq 0$). As a result this optimization model will become nonlinear. In order to obtain a linear model (i.e., piecewise linear and convex) the demand curve is divided into pieces and a constant relation is estimated based on the central point. In other words the relationship of supply and demand is described using a step ladder. In figure 2 a step ladder to model a realistic demand curve is shown. Any data of a supply and demand relationship is only valid within a certain interval $[Q_{min}; Q_{max}]$. Elasticity and consumers willingness to pay are based on empirical observations that are only valid close to the observation point. For the demand we specify a nominal demand, denoted $Q^0$. According to the definition the price and demand in an initial state of equilibrium and consumers are willing to pay the price of $P^0$ in order to obtain $Q^0$ quantity. It is obviously that $Q^0 \in [Q_{min}; Q_{max}]$ should be hold. The lengths of the steps in each direction must be specified prior to optimization. Either the step lengths can be uniformly distributed i.e. all step sizes have the same length or varying step sizes would be choose.

Figure 2. Demand Curve and its Stepladder (Source: authors design).




We assume the set of consumers to be $S_C$. Each consumer will have a supply and demand relationship (linear or exponential). Furthermore their willingness to pay is dependent on quality, packing types in which the consumers receive the pellets. Consumers are willing to pay more if the pellets come in handy bags than impractical bulks. Thus, the willingness to pay is varying for each consumer and dependents on packing types, time periods and qualities. If we show the nominal demand with $Q^0_{m,k,p,y,w}$ and assume that consumers are willing to pay the price $P^0_{m,k,p,y,w}$, then consumer $m \in S_C$ when obtains $Q_{m,k,p,y,w}$ of wood pellets $k \in S_Q$ in packing type $p \in S_\Omega$ during time period $(y, w) \in S_T$ will to pay $P_{m,k,p,y,w}$ per unit of wood pellet. It is assumed that the sets $S^-$ and $S^+$ illustrate the steps and denote the decreasing (left) and increasing (right) direction of $Q^0_{m,k,p,y,w}$ respectively. Also it is assumed that the payment price (willingness to pay) in steps $\delta^- \in S^-$ (that is the decreasing direction (-)) is $P^-_{\delta^-,m,k,p,y,w}$ and in steps $\delta^+ \in S^+$ (that is the increasing direction (+)) equals to $P^+_{\delta^+,m,k,p,y,w}$ . Note that $m \in S_C$, $k \in S_Q$, $p \in S_\Omega$ and $(y, w) \in S_T$. The sum of the price willingness $P^-_{\delta^-,m,k,p,y,w}$ and $P^+_{\delta^+,m,k,p,y,w}$ obtains specific data which depends on E and aforementioned relationship. In figure 2, the payment prices are assumed as centre of the step. It is assumed that $Q^-_{\delta^-,m,k,p,y,w}$ is the quantity of wood pellets in steps $\delta^- \in S^-$ and $Q^+_{\delta^+,m,k,p,y,w}$ is the quantity of wood pellets in steps $\delta^+ \in S^+$. The step lengths are bounded by the maximum size of each step lengths:

$$0 \le Q^-_{\delta^-,m,k,p,y,w} \le \bar{Q}^-_{\delta^-,m,k,p,y,w} \quad (2)$$
$$0 \le Q^+_{\delta^+,m,k,p,y,w} \le \bar{Q}^+_{\delta^+,m,k,p,y,w} \quad (3)$$

Where $\bar{Q}^-_{\delta^-,m,k,p,y,w}$ and $\bar{Q}^+_{\delta^+,m,k,p,y,w}$ are the step length specified by data. Furthermore the condition $\sum_{\delta^- \in S^-} \bar{Q}^-_{\delta^-,m,k,p,y,w} \le Q_{min} \wedge \sum_{\delta^+ \in S^+} \bar{Q}^+_{\delta^+,m,k,p,y,w} \le Q_{max}$ must be considered. It is clear that the model must rigor in choosing the steps (for instance, $Q^{-}_{\delta_2^-,m,k,p,y,w}$ prior to $Q^{-}_{\delta_1^-,m,k,p,y,w}$) and must consume all the capacity (for instance, $Q^{-}_{\delta_1^-,m,k,p,y,w}$ before giving a value to $Q^{-}_{\delta_2^-,m,k,p,y,w}$). Also, we cannot choose the steps in both directions. Therefore the said model is regularized in such a way that it will not be optimal to use steps in opposite directions at the same time or subsequently. In order to simplify the constraints of the model we assume that $Q_{m,k,p,y,w}$ is the total demand of consumer $m$ and is defined as below

$$Q_{m,k,p,y,w} = Q^0_{m,k,p,y,w} + \sum_{\delta^+ \in S^+} Q^{+}_{\delta^+,m,k,p,y,w} - \sum_{\delta^- \in S^-} Q^{-}_{\delta^-,m,k,p,y,w} \quad (4)$$

The utility $\Delta U_{m,k,p,y,w}$ is defined as

$$\Delta U_{m,k,p,y,w} = \sum_{\delta^+ \in S^+} p^{+}_{\delta^+,m,k,p,y,w} Q^{+}_{\delta^+,m,k,p,y,w} - \sum_{\delta^- \in S^-} P^{-}_{\delta^-,m,k,p,y,w}\, Q^{-}_{\delta^-,m,k,p,y,w} \quad (5)$$

In order to identify the market equilibrium, the utility is maximized by minimizing the production costs. Thus, the model uses as much of the capacity close to $Q^0_{m,k,p,y,w}$ .

### 3.3. Production

The set of producers or production facilities are denoted by $S_P$. Since the pellets can be produced pre-order of consumers, hence the production of wood pellets does not depend on the type of packaging. Accordingly, we isolate the production of wood pellets from the current stream of wood pellets and define the production process. In the first stage, we assume that $S_R$ is the set of available raw materials; $S_Q$ denotes the different quality types and $P_{m,k,r,y,w}$ is the production of wood pellet types $k$ at the production facility m using the raw material type $r$ during time period $(y,w)$ where $m \in S_P$, $k \in S_Q$, $r \in S_R$ and $(y,w) \in S_T$. The production of wood pellets at producer $m \in S_P$ of quality $k \in S_Q$ in $(y,w) \in S_T$ is

$$\text{The Production of Wood Pellets}_{m,k,y,w} = \sum_{r \in S_R} P_{m,k,r,y,w}$$

The variable $P_{m,k,r,y,w}$ is always non-negative. The production variable may be bounded by an upper bound denoted by $\bar{P}_{m,k,r,y,w}$. The boundary condition of the production variable is $0 \leq P_{m,k,r,y,w} \leq \bar{P}_{m,k,r,y,w}$. It is obvious that there must be a capacity of each production facility. Yearly production capacity is used in the model. The yearly production capacity is based on workers, machines and etc. That limits the yearly capacity independent of qualities and raw materials. If $CP^P_{m,y}$ denote the yearly capacity of producer $m \in S_P$ in year $y \in S^Y_T$ then the model must ensure that:

$$\sum_{k \in S_Q} \sum_{r \in S_R} \sum_{w \in S^W_T} P_{m,k,r,y,w} \leq CP^P_{m,y} \quad (6)$$

### 3.4. Network

Wood pellets are shipped from production site to consumption location (that is, cambium) and frequently this process is done via the ship. Shipping, packing and stocking of the pellets are parts of the flow network problem in given time periods. A transportation network is assumed to be specified prior to optimization.

### 3.4.1. Network Modeling

The basis of the wood pellet distribution of the overall model can be formulated as a multi commodity network flow problem. That is a network flow problem with multiple commodities routing through a (directed or undirected) network. A set of margins denote $E$ and a set of vertices denote $V$. Thus, a graph with $G = (E, V)$ coordinates can be plotted. Often the objective function is to minimize the cost of routing the flow through the network[12]. In the first stage, we consider a directed or connected network graph $G = (E, V)$ and a set of commodities $T^C$. Let $x_{i,j,t}$ denote the flow between i to j of commodity t where $(i, j) \in E$, $j \in V$ and $t \in T^C$. Also the maximum capacity of the margin $(i, j)$ with regards to t and the cost of using margin $(i, j)$ while sending commodity t are denoted by $\bar{x}_{i,j,t}$ and $C_{i,j,t}$ respectively. The net flow of commodity t assumed as $b_{i,t}$ . If node i is a source then $b_{i,t} > 0$, if node i is a sink then $b_{i,t} < 0$ and if i is a transshipment node then $b_{i,t} = 0$. According to mentioned hypothesizes, minimizing the distribution cost will be as below.

$$\sum_{i,j\in V} \sum_{t\in T^C} c_{i,j,t} . x_{i,j,t} \qquad (7)$$

Sub.to:

$$\sum_{j\in V} x_{i,j,t} - \sum_{j\in V} x_{j,i,t} = b_{i,t}, \qquad \forall_i \in V, \forall_t \in T^C$$
$$0 \le x_{i,j,t} \le \bar{x}_{i,j,t}, \; \forall (i,j) \in E, \forall_{i,j} \in V, \forall_t \in T^C \qquad (8)$$

The constraint (8) ensures that total flow of commodity t exiting and entering a node equals the net flow of the node. The objective (7) minimizes the distribution cost of commodity t.

### 3.4.2. The Flow Variable

Producers, wholesalers, retailers and consumers are all defined as nodes in the network graph $G = (E, V)$. By recall the set of producers which was denoted by $S_P$ and the set of consumers $S_C$, the set of wholesalers and retailers will be denote by $S_W$ and $S_H$ respectively. It is clear that $S_P$, $S_W$, $S_H$ and $S_C$ are subsets of the set of vertices $V$ in the graph $G$ and thus $V = S_P \cup S_W \cup S_H | \cup S_C$. Therefore, the set $E$ denotes the set of connections $(m, n)$ where $m, n \in V$. The transportation of wood pellets in the network is done in different packing types. The unit cost of transporting a wood pellet in bulk form is substantially less than transporting the same wood pellet in small bags. Thus, we must act wisely in selecting a way the wood pellets are transported through the network. As discussed before, $S_\Omega$ denotes the set of packing types in the network. In order to simplify assume that the set of sellers is $S_V = S_P \cup S_W$ and the set of buyers is $S_B = S_W \cup S_C$ where $(i, j)$ is true as $i \in S_V$ and $j \in S_B$. Suppose that $x_{m,n,k,p,i,j,y,w}$ denotes the flow $m \in V$ to $n \in V$ of the packing units number $p \in S_\Omega$ with wood pellet type $k \in S_Q$ produced or resold at $i \in S_V$ and purchased by $j \in S_B$ during time period $(y, w) \in S_T$ . Then a commodity denotes $t = (k, p, i, j)$. We consider the flow to be non-negative. Furthermore the flow variable may be bounded thus the boundary conditions will be as $0 \le x_{m,n,k,p,i,j,y,w} \le \bar{x}_{m,n,k,p,i,j,y,m}$ where $(m, n) \in E$. Note that not all of the margins are able to be used for all types of $k \in S_Q$ and $p \in S_\Omega$. Thus, a sub graph must be specified in order to link all $(m, n, k, p)$ and $(i, j, k, p)$ that only feasible commodities are sent using the correct margins in $E$. Furthermore, the transportation links may have a capacity of possible flow which

[12] In this research, multi commodity network flow is formulated by defining minimum cost flow which is introduced by Hillier & Lieberman (2005).

is being decentralized distributed on a margin. By assuming that the transportation capacity margins are $CP^T_{m,n,k,p,y,w}$ then the condition 9 must be ensured.

$$\sum_{i\in S_V}\sum_{j\in S_B} x_{m,n,k,p,i,j,y,w} \leq CP^T_{m,n,k,p,y,w} \tag{9}$$

If the cost of transporting a unit of packing type $p \in S_\Omega$, of quality $k \in S_Q$, during time period $(y, w) \in S_T$, at margins between $n \in V$ and $m \in V$ equals to $(i, j) \in E$ then the transportation cost will be as equation 10.

$$\text{The Cost of Transportation} = \sum C^T_{m,n,k,p,y,w} \cdot x_{m,n,k,p,i,j,y,w} \tag{10}$$

### 3.4.3. Cost and Packing Capacity

The packing of product can be in bulk which will include 25000 tonnes of pellet whereas small bags might contain 25 or 50 kg of pellets. As mentioned previously, the set of packing types is denoted by $S_\Omega$. Moreover, the quantity of packing sizes is assumed as $\omega_p$. The number of wood pellet tonnes transported on the margin $(m, n) \in E$ of commodity type $(k, p, i, j)$ during time period $(y, w)$ is

$$\text{The Number of Wood Pellets}_{\,m,n,k,p,i,j,y,w} = \omega_p . x_{m,n,k,p,i,j,y,w}$$

Packing wood pellets include a cost. We denote the packing cost of every unit of packing types in node $m \in V$, of quality $k \in S_Q$ during time period of $(y, w) \in S_T$ as $C^\omega_{m,k,p,y,w}$. Intuitively the cost of packing should be implemented on existing flow thus the cost of storage is then defined by equation 11.

$$\text{The Cost of Storage} = \sum C^\omega_{m,k,p,y,w} \cdot x_{m,n,k,p,i,j,y,w} \tag{11}$$

### 3.4.4. Storage Variable

Producing Pellets during the summer is less expensive than producing them in the heating season. The reason of reduction in production cost in this season is mainly for the sake of the raw material supply[13] and decrease in demand. Thus, in the model a storage possibility must be considered. When a node has a storage possibility, it is assumed that $V_{m,k,p,y,w}$ is packing units $p \in S_\Omega$ of $k \in S_Q$ quantity in node $m \in V$ during the period $(y, w) \in S_T$ . When production cost is low the producers can produce more pellets because of obtaining more profits and store the produced products in the storage. The demand of a consumer is defined as consumed pellets in a given period. If a consumer purchase wood pellets in the summer but are planning to consume them in the heating season then the wood pellets are stored during the mean time. When the pellets are consumed, the consumers obtain the pellets utility. It is important to differentiate between the wood pellet costs and the wood pellet utility which both enters the objective function. In order to clarify the problem, consider this example. The consumer purchases wood pellets in week x and consumes them in week y. The pellets are stored during weeks (x to y). In the objective function the costs of production and distribution are paid in week x. Thus a storage cost is added to the objective function in week x to y. As the consumers do not utilize the pellets before week y, the objective obtains the utility of consumed pellets in week y. Pellets are counted in the storage facilities during the first or the end of a time period. Pellets are counted,

[13] Sawdust is the main material in pellet production. But any types of Conifers (such as Pine), Broad leaves and Agricultural residuals can be used.

in the model of this research, during the end of time period. Thus, the values of $V_{m,k,p,y,w}$ are the items on stock of node $m \in V$, quality k, packing type $p \in S_{\Omega}$ at the end of time period $(y,w) \in S_T$ . The storage variable is non-negative and may be bounded. By assuming $\bar{V}_{m,k,p,y,w}$ as upper bound of storage then $0 \leq V_{m,k,p,y,w} \leq \bar{V}_{m,k,p,y,w}$ will be known as boundary conditions. Moreover, there might a weekly maximum storage capacity exists independent of quality and packing size. Thus, the following condition must be ensured

$$\sum_{k \in S_Q} \sum_{p \in S_{\Omega}} \omega_p . V_{m,k,p,y,w} \leq CP^V_{m,y,w} \quad (12)$$

There is a cost associated with storage. If storage cost in node m, of quality $k \in S_Q$, in packing type $p \in S_{\Omega}$ and during time period $(y,w) \in S_T$ is considered as $C^V_{m,k,p,y,w}$ , then total storage cost will be as equation 13

$$\text{Storage Cost} = \sum C^V_{m,k,p,y,w} . V_{m,k,p,y,w} \quad (13)$$

The flow preservation constraints ensure that flow in and out of the storage is equivalent.

### 3.4.5. Producers

The exiting flow must not exceed the production. First of all the following condition must be ensured:

$$\sum_{n \in V} \sum_{p \in S_{\Omega}} \sum_{j \in S_B} \omega_p . x_{m,n,k,p,i,j,y,w} \leq \sum_{r \in S_R} P_{m,k,r,y,w} \quad (14)$$

Where $m \in S_P$, $i = m$ and $(k,p,i,j)$ is a feasible and transportable commodity. By increasing in the storage at the production facility the constraint becomes slightly more complex. In this case, the flow preservation constraints must be divided into three parts: The initial time period, the first week of each year and a general case. In the initial time period the storage have $V^0_{m,k,p}$ value. In the first week of each year (without considering the first year) the storage has the value of the storage at the end of the final week of the previous year. During the other time periods the storage has the end value the previous week. According to the notes presented above, the flow preservation constraints at the producers will be as below:

$$\sum_{n \in V} \sum_{p \in S_{\Omega}} \sum_{j \in S_B} \omega_p . x_{m,n,k,p,i,j,y,w} + \sum_{p \in S_{\Omega}} \omega_p . V_{m,k,p,y,w} \leq \sum_{r \in S_R} P_{m,k,r,y,w} + \begin{cases} \sum_{p \in S_{\Omega}} \omega_p . V^0_{m,k,p} \\ \sum_{p \in S_{\Omega}} \omega_p . V_{m,k,p,y-1,card\,(S^W_T)} \\ \sum_{p \in S_{\Omega}} \omega_p . V_{m,k,p,y,w-1} \end{cases} \quad (15)$$

If $ord(S_T)$ equals to 1 then we will use $\sum_{p \in S_{\Omega}} \omega_p . V^0_{m,k,p}$ condition, if $ord\,(S^W_T) = 1 \wedge ord\,(S^Y_T) > 1$ then we will use $\sum_{p \in S_{\Omega}} \omega_p . V_{m,k,p,y-1}$ condition and otherwise we will use

$\sum_{p\in S_\Omega} \omega_p . V_{m,k,p,y,w-1}$ condition. We note that in the above condition, the ordinal set of S is denoted by $ord(S)$ and the cardinal set of S is denoted by $card(S)$.

### 3.4.6. Wholesalers and Consumers

The consumers' consumption is determined by the cost of production and distribution as previously described in details. It is clear that the entering flow in the consumer nodes should be able to satisfy the demand $Q_{n,k,p,y,w}$ thus:

$$Q_{n,k,p,y,w} \leq \sum_{m\in V} \sum_{i\in S_V} x_{m,n,k,p,i,j,y,w} \quad (16)$$

Where $n \in S_C$, $j = n$, $p \in S_\Omega$ and $(y, w) \in S_T$. The storage must be included in the preservation flow.

$$Q_{n,k,p,y,w} + V_{n,k,p,y,w} \leq \sum_{m\in V} \sum_{i\in S_V} x_{m,n,k,p,i,j,y,w} + \begin{cases} V^0_{n,k,p} \\ V_{n,k,p,y-1,card(S_T^W)} \\ V_{n,k,p,y,w-1} \end{cases} \quad (17)$$

There will not be any cost during commodity transmission through a wholesaler. If we let $C^W_{m,k,y,w}$ denote the cost of wholesaler and $W_{m,k,y,w}$ denote the purchase of wholesaler then the cost of wholesalers can be calculate by equation 18:

$$\text{The cost of Wholesalers} = \sum C^W_{m,k,y,w} . W_{m,k,y,w} \quad (18)$$

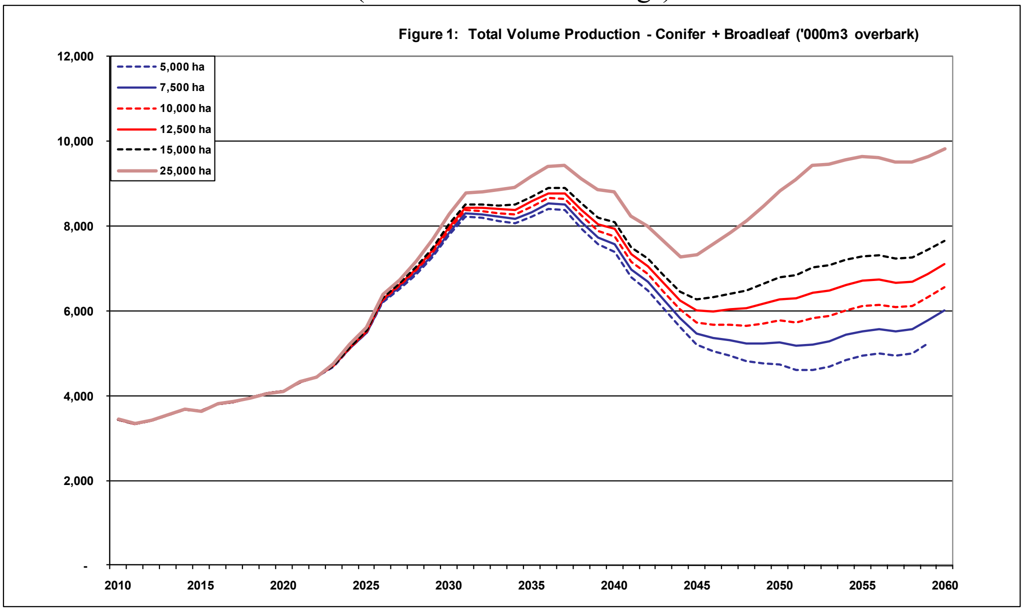
The significant role of wholesalers can be discussed. The accomplishment in the model defines the wholesalers as a middle link between producers and consumers with fixed revenue per ton.

## 4. Empirical Results

### 4.1. Wood Pellets Quality

In the first stage 10,000 ha are considered as baseline. Irrespective of the afforestation level, the projected total volume supply curve shows a steady increase up to 2030, followed by a smaller rate of increase to 2035 followed by a period of steady decline, which is then followed by a period of slowly increasing production (Figure 3). The peak in production in 2035 shows only minor differences between the different afforestation scenarios. However, the duration and depth of the subsequent trough in production shows major differences between the afforestation levels. The baseline of 10,000 ha peaks at almost 9 million cubic meters in 2035 but then declines by 50% to less than 6 million over a period of ten years.

Figure 3- Total production amount - Conifer and Broadleaf species
(Source: research findings)




Increasing the afforestation level reduces the drop in volume production and the duration of the period of decline. Reducing the afforestation level from the baseline has the opposite effect. A broadly similar pattern of projected round wood volume supply is shown when only conifers are considered (Figure 4). Due to the pattern of broadleaf planting, which has seen a steady increase over the past two decades, and the assumption that reforestation sites from the private sector will be planted with a significant broadleaf element, the projected volume supply curve for broadleaves has a quite different shape to that for conifer volume production (Figure 5).

Figure 4- Conifer Production (Source: research findings)

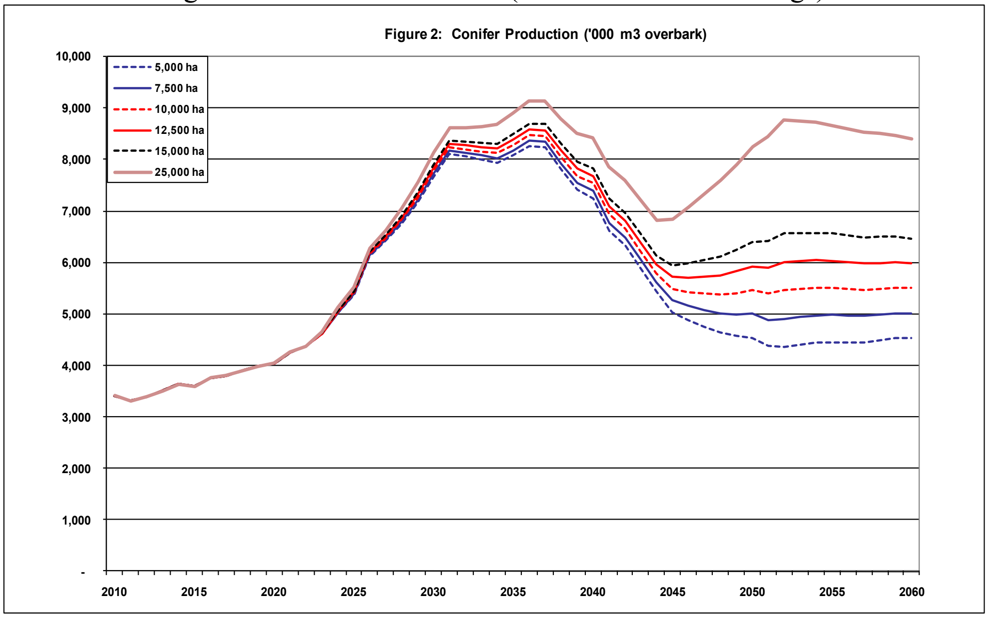
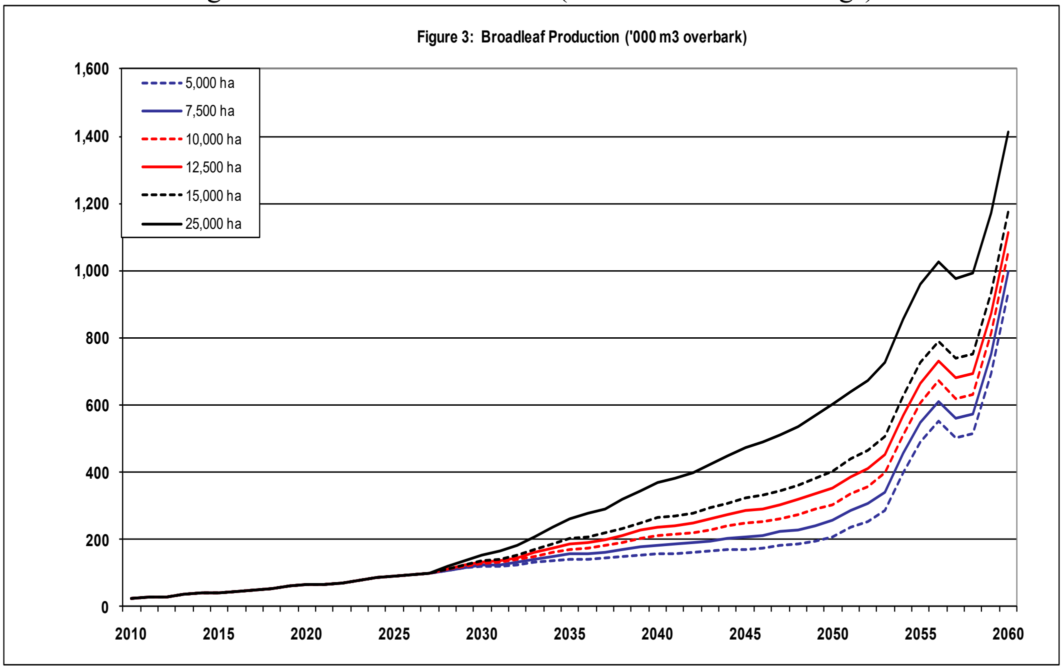


Figure 5- Broadleaf Production (Source: research findings)




Broadleaf production is projected to increase at an even rate from a low base of circa 26,000 cubic meters in 2010 up to 500,000 cubic meters by 2053. This increase continues more rapidly to 2057 with an increasing rate and then decreases by clear-cutting during one year. This trend, again, follows an increasing trend by applying environmental surveillances and supportive policies and continues up to 2060. Based on the presented results it can be inferred that the trend of pellet consumption would not decreased in the coming years and the mentioned trend is close to EU 2020 targets based on providing safe energy.

## 4.2. Estimating the Relationship between Supply And Demand

First we assume that the nominal prices and quantities are only starting points of the optimization process. The price elasticity of the demand is estimated to 10%. Thus, for all consumers (in macro and micro scales), the increase of prices by 10% will reduce the quantity demanded by consumers about 1%. Furthermore we assume that the relationship between supply and demand is exponential[14]. The number of steps which are used in the optimization process is 8 in each direction and one step is in the middle. The price value of the step is determined by the middle value of the interval. The first step (in the middle) in decreasing and increasing direction is conjugated thus there in total is 17 steps. In order to simplify, we consider a fixed percentage of price change. As different types and quantities of wood pellets being demanded, it seems that estimating the relationship between supply and demand is more important generically. Therefore, all of the relationships have same standard properties and the steps are as a fixed percentage. In table 1 the chosen percentages of the increasing (+) and decreasing (-) are presented. The supply and demand relationship is modelled from top to down. Thus, the known nominal prices are only valid within small range of changes. Whatever we move further away from the nominal prices the reliability of the estimates reduces. Therefore we implement small steps close to nominal prices where we trust our estimated relationship to increase.

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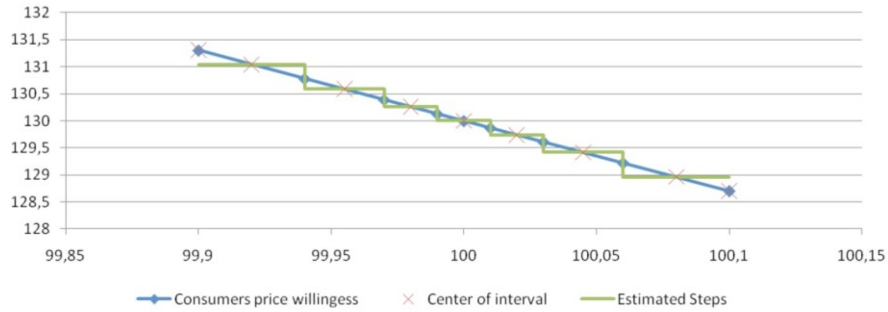
[14] - According to Hansen et al (2003) an exponential relationship between supply and demand is more realistic than linear relationship.

Table 1- Increase (+) and Decrease (-) of Price Payments by Consumer Dependent on Previous Interval (Source: research findings)

| Steps | Step 0 | Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 | Step 8 |
|---|---|---|---|---|---|---|---|---|---|
| (+) | 0.1% | 0.2% | 0.3% | 0.4% | 0.5% | 0.6% | 0.7% | 0.8% | 0.9% |
| (-) | 0.1% | 0.2% | 0.3% | 0.4% | 0.5% | 0.6% | 0.7% | 0.8% | 0.9% |

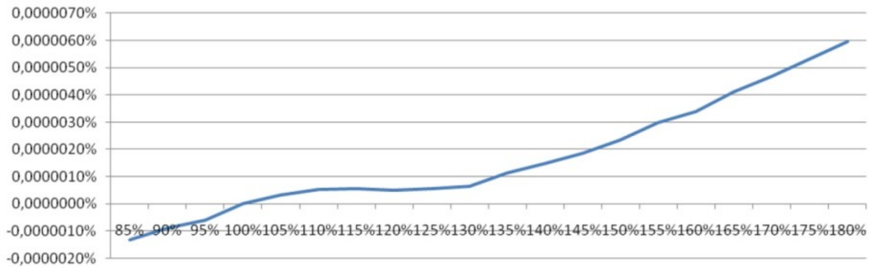
The demand for standard pellets with 10% of price elasticity is shown in figure 6 for 500,000 tons of demanded pellets per year (in Bulk) in Europe during the first week. In figure 6 only the first three steps (steps 1, 2 and 3) and step 0 is shown. It is clear that the total lengths of the steps are then 4-5% of the nominal consumption.

Figure 6- CHP Stepladders in Europe (Source: research findings)




The steps determine how much the consumption is able to increase and decrease before we have to change consumer's prices. The chosen step lengths are estimated based on understanding of elasticity and consumption. The highest percentage of the consumption is able to change about ±4-5% and depends on the nominal prices. Hence, the relationship between supply and demand will change where the step lengths are varied 85% of original lengths to 180% of original lengths with 5%, 10% and 15% elasticity. It is clear that if the step lengths become larger, then the model is able to increase the consumption more to a higher price. In figure 7 the change in the objective function is illustrated. First noticed is that the changes in the objective seem small. Around 100% and 135% of the original steps lengths the objective does not change much. As the change in objective function is linear and the changes are small, we can conclude that the model being indifferent to the changes in step lengths.

Figure 7- Change in Objective Function due to the Change in Step Lengths (Source: research findings)




As discussed before, $Q^0_{n,k,p,y,w}$ is the nominal amount of wood pellets a consumer is willing to buy for a certain price. In order to be confident in estimation of the cost parameters, we expect that $Q$ (consumption) become near to $Q^0$ in 2013 and after 2013 the consumers' willingness to pay would be changed thereby changing the consumption (figure 8).

Figure 8- The Average Percentage Change in Quantities Consumption
(Source: research findings)


To compare the different consumptions, the percentage change in consumption is calculated by equation 19:

$$\Delta Q_{m,k,p,y} = \sum_{w} \frac{Q^{+}_{\delta^{+},m,k,p,y,w} - Q^{-}_{\delta^{-},m,k,p,y,w}}{Q^{0}_{m,k,p,y,w}} \qquad (19)$$

As the demanded quantities are not same in scale, it is clear that a percentage change in calculated bags (to tonnes) is less than the percentage change in produced pellets (in bulk). Also, because of non-adjustment between demand scale and possible change, the change in quantities (in tonnes) will be challengeable. For instance, we can mention to the Italian private consumers demands of 600,000 premium pellets in bags. Whereas, this amount of demand is about 6000 premium pellets for the Danish industrial consumers. Therefore the relative percentage change in consumption from the nominal demand is considered in order to compare their consumption.

Table 2- Nominal Prices $P^0$, Reduced Costs of Consumption and Change in Demand $\Delta Q$ for all Consumers (Source:research findings)

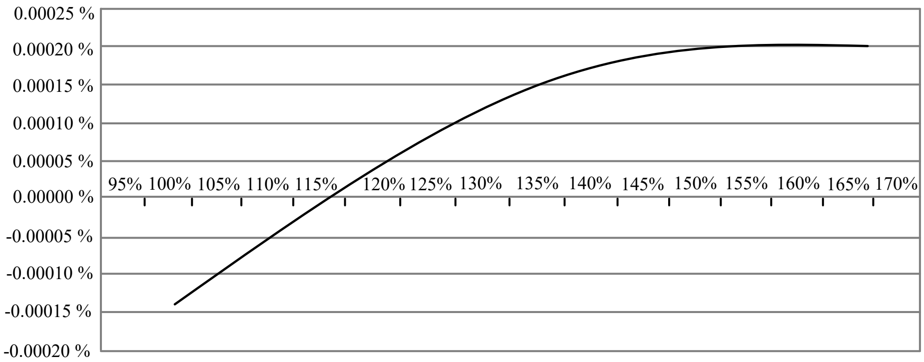
| Consumption Site | $\Delta Q$ (In %) | $P^0$ (In Rials/Ton) | $RC_Q$ (In Rials/Ton) |
|---|---|---|---|
| Personal Consumption | | | |
| Premium and in Bulk | -0.1% | 12816000 | 12960000 |
| Premium and Bagged | -0.1% | 13632000 | 13776000 |
| Industrial Consumption | | | |
| Premium and in Bulk | -0.1% | 11040000 | 11232000 |
| Premium and Bagged | -0.1% | 13632000 | 13776000 |
| CHP Consumption | | | |
| Standard and in Bulk | -0.3% | 6240000 | 6432000 |
| Standard and Bagged | -0.3% | 8256000 | 8496000 |

According to table 2, it is clear that the amount of consumption decreases when consumers' prices are increased. The presented $RC_Q$ index in table 2 indicates the total cost of supplying pellets to the consumers. If the cost becomes higher than the nominal prices the consumption will decrease and if the cost becomes lower than the nominal prices the consumption will increase. We can see these changes in figure 7.

Figure 7- The Percentage Change in Premium and Standard Pellets Consumption (Source: research findings)


According to the results, we can study the changes in objective function. The increase trend stabilizes when raw material capacity is about 150% of the original capacity. The total production capacity is fully utilized or in short-run the production of standard pellets will take place when the capacity is about 145% of the original capacity. With this sudden change (from an increasing trend to a constant) the production process would runs out of total yearly capacity (figure 8).

Figure 8- The Change in Objective Function due to the Change in Capacity (Source: research findings)



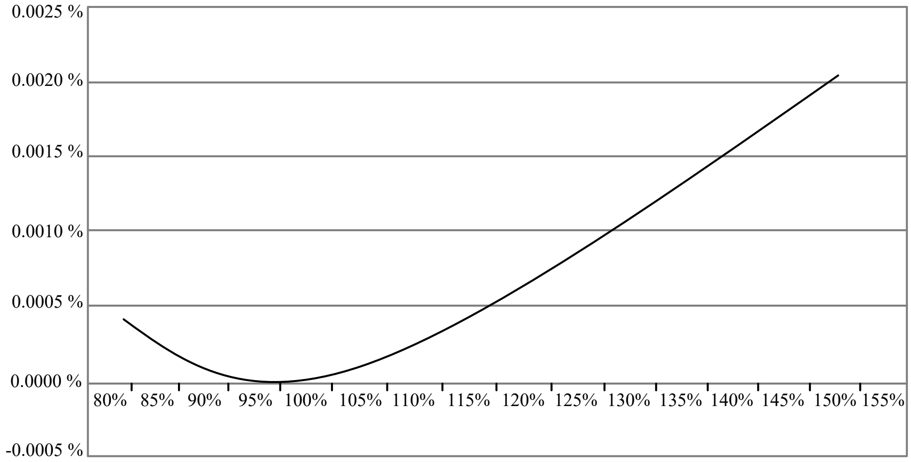

Generally the increase in raw material capacities and thereby the increase in production capacities of a specific pellet quality does not result in much increased consumption. In fact the production moves from one production unit to a cheap production unit15. For instance Italy has advantage in production than European countries because of type of packing, cheap raw materials and selling directly to the consumers. In other words, According to the reduced cost, Italy has a lot of economic rent (ownership)[16] and for this reason this country is not affected by changes. Moreover, the increase in capacities mostly affects the production. Less expensive producers increase their market share while other producers seek to decrease their market share. Also, slight changes in consumers' nominal prices ($P^0$) affect the total consumption. It may seems that increase in $P^0$ will cause a higher rate of consumption of wood pellets by recalling

[15] - When the capacity increases, mostly, the production from other areas moves to the area with increased capacity. In some areas, the increase in capacity (as more pellets are produced) affects the consumption significantly.

[16] - It is assumed that the systems of countries which have a large economic rent and are restricted by their production capacity is not perfect competition.

the nominal consumer price willingness with a price elasticity of the demand equalling 10%. As premium pellets are a spare resource, therefore, we investigate the price willingness of premium pellets in Bulk and Bags. As it become more economical for the producers to sell more wood pellets, it may be thought that an increase in $P^0$ will result in a higher consumption. The existence of available production capacity is the main reason of producers' ability in increasing their sells. The change in objective function due to the change in $P^0$ is illustrated in figure 9.

Figure 9- The Change in Objective Function due to the Change in Price Payments by Consumer (Source: research findings)




It seems that the objective function increases when the nominal price increases because more pellets are consumed. The question asked here is why the objective function increases when the nominal price decreases. A possible explanation for this problem could be that the model is keener to jump a step and thus decrease costs of production and distribution. Production, Packing, Wholesaler, Retailer, Storage and transportation costs are part of costs which we can face in pellet trade and the main costs are production and wholesaler costs. The production is affected when increasing or decreasing production costs of any producers[17].

Table 3- Production Cost, Reduced Cost and Economic Rent of Premium and Standard Pellets (Source: reseaarch findings)

| Producers | Standard Pellets Production Cost (in Rials/t) | Premium Pellets Production Cost (in Rials/t) | Standard Pellets Reduced Cost (in Rials/t) | Premium Pellets Reduced Cost (in Rials/t) | Standard Pellets Economic Rent (in Rials/t) | Premium Pellets Economic Rent (in Rials/t) |
|---|---|---|---|---|---|---|
| Europe | 4992000 to 7392000 | 7200000 to 7392000 | 4992000 | 7200000 | - | - |
| U.S. | 4032000 to 4224000 | 4176000 to 4224000 | 4272000 | 6672000 | 48000 to 240000 | 2448000 to 2496000 |

17 - if the change in objective function is linear then all consumers are affected when production costs are varied.

| | | | | | | |
|---|---|---|---|---|---|---|
| Russia | 3600000 to 4608000 | 4416000 to 4608000 | 3360000 | 4368000 | - | - |

The production cost depends on the raw materials. Producers in Russia and Europe would not benefit by producing one unit. These producers are not bounded by any sparseness in production. When there are no spare resources the marginal cost (MC) is equal to marginal revenue (MR)[18]. The United States is limited by the raw material capacity. The difference in production cost and the reduced costs of production balance reveals the economic rent of the producers[19]. In fact, economic rent occurs when there is a lack of competition in a market.

## 5. CONCLUSION

As expected, the consumption decreases in the years of 2011 and 2012 and increases during the years 2013 and 2014. In other words, as the willingness increases the consumption increases and stabilizes around 0.5-1% increase from the nominal consumption $Q^0$. The consumption trend of pellet with the gentle slope is additive. The obtained result conforms to the EU 2020 goals. The production site in Russia is barely utilized but has very little reduced costs of production. The United States is utilizing all of its capacity of raw material thus not being able to produce any more premium pellets. Generally when increasing raw material capacities and thereby increasing production capacities of a specific pellet quality, this trend does not result in much increased consumption. In fact the production moves from one production unit to a more inexpensive production unit. In the given model the price elasticity is small. Small price elasticity implies that consumer is not sensitive to the price changes. But when elasticity is high, small changes in demand entails larger changes in consumers' demand. This result become more important as the changes in price which the consumer will to pay can be considered as subsidies or expectation of consumer's development. By increasing and decreasing production cost simultaneously, mainly the producers are affected. If the production cost increases more than the economic rent other production sites will be available to take market share. According to the reduced cost there will be more opportunities in the market of a country which has high reduced cost because of not affecting from changes. As it seems that construction of Pellet plants inside the country become justifiable, therefore in order to achieve this important recommendations expressed as below

1. As capital expenditures are funded from oil sales thus the purpose is to fund the current budget from non-oil revenues. For this purpose general policies of Article 44 and Civil Service Management Law must be used properly and also according to the 13, 14, 15 and 115 materials of Civil Service Management Law the current government services must be outsourced to the private sector instead of increasing the government volume.

2. It is useful in the field of export that export substitution policies be emphasized instead of encouraging export policies, because more value added will obtain and the terms of trade will improve.

## ACKNOWLEDGMENTS

None.

## ETHICAL CONSIDERATION

[18] - For more detail refer to Hansen et al (2003).
[19] - For more information refer to Tollision (1982).

Authenticity of the texts, honesty and fidelity has been observed.

**AUTHOR CONTRIBUTIONS**

Planning and writing of the manuscript was done by the authors.

**CONFLICT OF INTEREST**

Author/s confirmed no conflict of interest.

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